Comparison of patterns in knowledge diffusion from the US to South East Asia (Korea and Taiwan) and Latin America (Brazil and Mexico), 1976-2002

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Abstract

The aim of this paper is to compare the patterns in diffusion of knowledge from the US to South East Asia (Korea and Taiwan) and Latin America (Brazil and Mexico) and to explore the nature of technological flows between these two regions during the 1976-2002 period. The patterns of knowledge diffusion from the US to Brazil and Mexico, and Korea and Taiwan during the 1976-2002 period are quite different. We found that the South East Asian countries had a higher number of patents granted in USPTO than their Latin American counterparts. Furthermore, the technologies registered in Korea and Taiwan were of high technology (Information and Communications, Electric and Electronics, etc.) meanwhile in Latin America (Brazil and Mexico) the technologies registered were of traditional tech fields (mechanical, chemical, etc.). Besides, the citations received (forward) by Korea and Taiwan outnumbers the citations received by Mexico and Brazil. That means that the value of knowledge in Asian countries is more important than it is in Latin American countries. This is very relevant because in the beginning of the analyzed period Latin American countries had the same technological distribution as these Asian countries.

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Introduction

In the last three decades USPTO and Taiwan changed from a traditional to a modern economy, while Brazil and Mexico remain in a traditional industrialization level and their adherence to the globalization process has been slow and incomplete. In fact, the regions these countries represent, have registered a very contrasting performance in their economic growth during the last decades[3]. The objective is to study some aspects of this contrasting performance through some tools coming from the economics of knowledge (Foray, 2004). In particular the paper explore of patterns of diffusion of knowledge from the USPTO to South East Asia (USPTO and Taiwan) and Latin America (Brazil and Mexico), 1976-2002

The paper is organized as follows. Part one describes the data used in this paper and methodology. In part, two We analyze the patenting patterns in USPTO for USPTO, Taiwan, Mexico and Brazil. The comparison of technological fields is studied in part tree for all countries. Part four studies the diffusion of knowledge through the citation (forward) from the USPTO to South East Asia (USPTO and Taiwan) and Latin America (Brazil and Mexico), 1976-2002. Finally, We present the main results of the research.

1. Data and Methodology

We use the methodology of Jaffe and Trajtenberg (2002) and Hu and Jaffe (2001). These authors used patent citation as a *proxy* of knowledge diffusion from a technologically advanced country (USPTO) to developing economies. The information used in this study consists of patents granted by USPTO to inventors based in Mexico, Brazil, Taiwan and Korea, between 1975 and 2002. Data was taken from the NBER Patent Citations Database updated by B. Hall in December 2004.

The sections of this database that were used for the patents granted to the studied countries were:

[3] Kim, L. and R. R. Nelson (2000) *Technology, Learning, and Innovation. Experiences of Newly Industrializing Economies.* Cambridge University Press. Chapters 1, 9 and 10.

?? Country of residence of first inventor

?? Dates of patent grant

?? USPTO classifications it belongs to

?? Backward citations in USPTO patents

?? Forward citations in USPTO patents

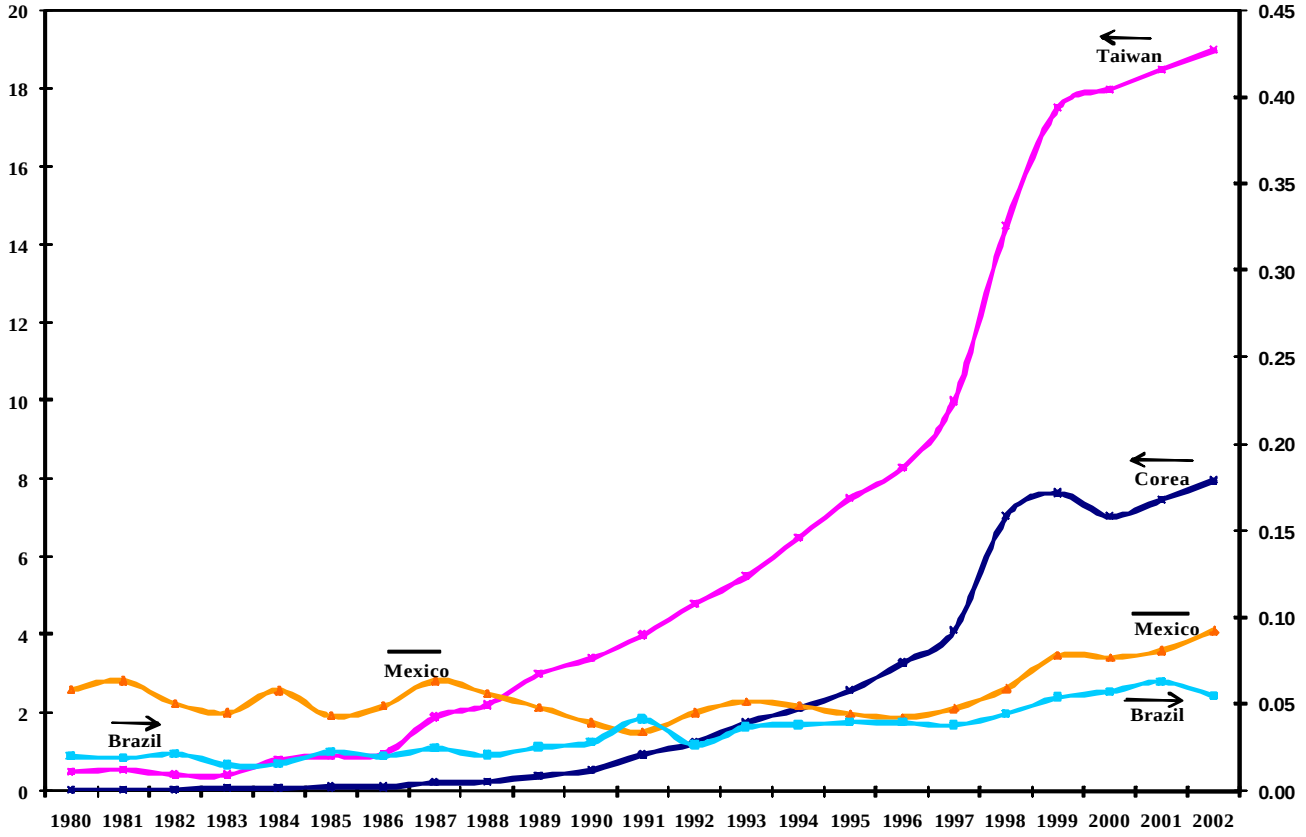
Given that USPTO is not a hierarchical classification system, Jaffe and Trajtenberg (2004) grouped all classifications into six main technological categories: Chemicals, Computers and Communications, Drugs, Electric and Electronics, Mechanical, and Others.

2. Patenting Patterns

The evolution in the patenting patterns of the studied countries is contrasting. The patenting per 100,000 inhabitants of Korea and Taiwan can be appreciated in the left scale, whereas the right scale shows that for Mexico and Brazil Graph 1. At the beginning of the studied period, there are no significant differences between these countries.

Graph 1, shows the number of patents per 100,000 inhabitants: Korea, Taiwan, Mexico and Brazil. As can be noted, Korean citizens patent 100 times more than their Mexican and Brazilian counterparts; the ratio goes up to 200 times in the case of Taiwan.

Graph 1. Number of patents per 100,000 inhabitants. Taiwan, Korea, Mexico and Brazil



Source: USPTO

3. Technological Fields

At the beginning of the studied period 1971-1980, patents in all countries were distributed along very similar technological fields, where Chemical, Mechanical and Other technologies were more outstanding (around 80% of the total) See Chart 1.

In the following period 1981-1990, Korea and Taiwan began to change considerably, while technology in patents granted in USPTO for their Latin American counterparts were still the same.

At the end of the studied period (1991-2002), Korea and Taiwan have drastically changed. The fields of ICT are the most prominent. This reflects a catching up process with regards to highly industrialized countries (US, Japan, EU). Almost

two thirds of their patents were in the fields of Computers, Communication and Electronics. Mexico and Brazil, in the mean time, continue to have most of USPTO patents in the traditional fields of Chemical, Mechanical and Others (more than 80% of patents were registered in these fields).

Chart 1. Evolution of Technological Fields (%)

	Mexico			Brazil			Korea			Taiwan		
Technological Field %	**71-80**	**81-90**	**91-02**	**71-80**	**81-90**	**91-02**	**71-80**	**81-90**	**91-02**	**71-80**	**81-90**	**91-02**
Computers - Comunication	1,2	0,5	3,8	4,2	2,4	4,0	2,7	11,1	28,3	4,2	5,0	8,8
Electrical - Electronic	7,0	8,2	6,9	5,7	7,3	9,4	8,2	28,6	36,7	11,9	15,0	36,3
Drugs	8,4	12,1	10,7	5,7	6,6	11,2	6,8	3,4	2,7	2,1	2,2	2,5
Chemical	21,9	15,5	21,4	20,3	14,6	17,1	27,4	13,5	10,5	12,7	6,7	7,2
Mechanical	29,5	35,1	28,7	29,7	37,2	25,6	19,2	17,5	12,2	24,2	25,5	19,2
Other	32,0	28,6	28,6	34,4	31,9	32,7	35,6	26,0	9,5	44,9	45,5	26,1
	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0
Total Patents	**488**	**388**	**665**	**192**	**288**	**883**	**73**	**739**	**24675**	**236**	**2840**	**32361**

Sourse : USPTO

The significance of these changing patenting patterns relies in the fact that Korea and Taiwan have joined the globalization process driven by new technologies. Mexico and Brazil for their part, remain in traditional technologies more normally associated to earlier stages of industrialization.

4. Diffusion of Knowledge

Backward citations in patents are the source of the new knowledge. Forward citations on the other hand, reflect the importance of technology. Patents receiving a great number of forward citations reflect that their embedded technology is very valuable[4]. Therefore, an increase of forward citations for some patents is associated with a growing value of knowledge. The total number of forward citations granted to Mexico, Brazil, Korea and Taiwan from 1971 to 2002. in USPTO can be seen in Graph 2. Two stages can be clearly appreciated. In the first one (1972-1985), all countries have a small number of forward citations. In the second one (1986-2002) Taiwan and Korea take off drastically, whereas Mexico and Brazil remain in the same level. Taiwan and Korea effectively reached the 8,000-12,0000 rank from 1994-1998. (The fall in forward citations seen from 1999 to 2002 is a normal behavior due to the great proximity to the granting date).[5]

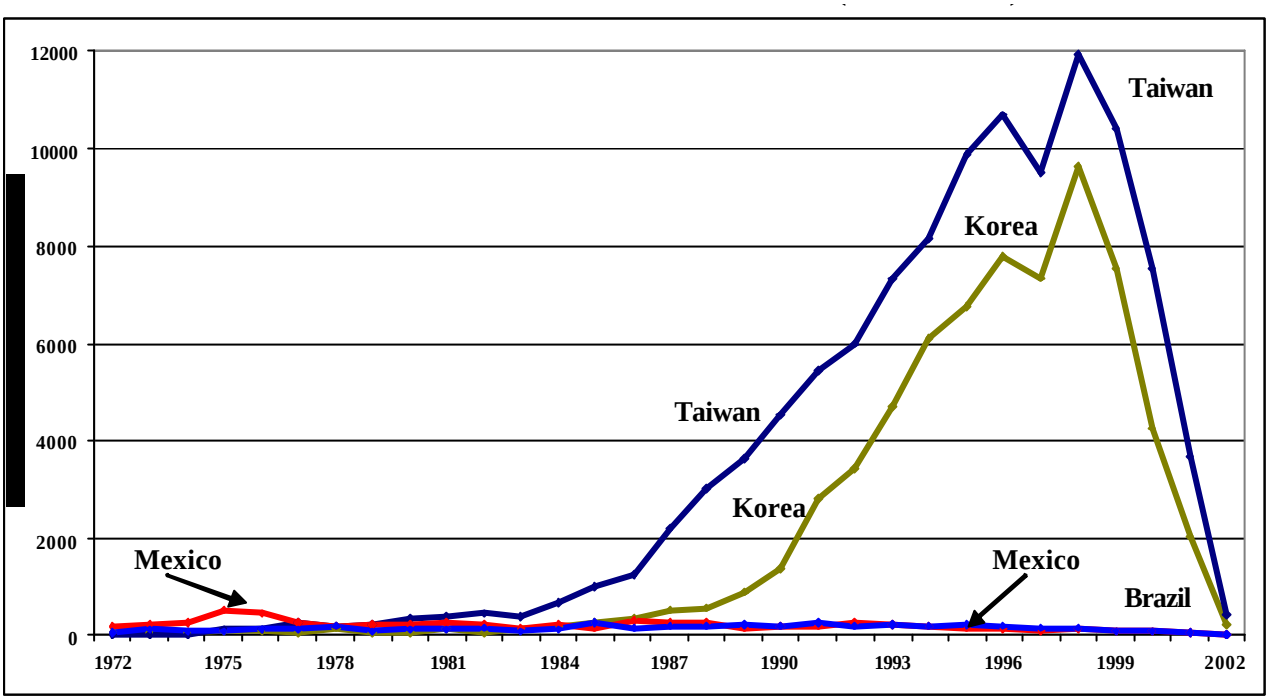
There is no doubt that the difference in the value of patents granted to Taiwan and Korea is enormous in comparison to those granted to Mexico and Brazil. This reflects different economic performance and industrialization patterns. As can be seen in chart 2 y 3 there is an increasing gap in terms of number of citations.

[4] See Hall et al. (2001), also Griliches et al. (1987).

[5] See Jaffe and Trajtenberg, 2002 for further explanation of this phenomenon .

Graph 2: Total of Citations Forward by Patents Granted by USPTO to Mexico, Brazil, Korea and Taiwan

(1972-2002)



Sourse: Hall, B. NBER,USPTO

5. Conclusions

The patterns of knowledge diffusion from the US to Latin-American countries (Brazil and Mexico) and South East Asian countries (Korea and Taiwan) during the 1976-2002 period are quite different. We found that the South East Asian countries had a higher number of patents granted in USPTO (see Chart 1 and Chart 2) than their Latin American counterparts. Furthermore, the technologies registered in Korea and Taiwan were of high technology (Information and Communications, Electric and Electronics, etc.) meanwhile in Latin America (Brazil and Mexico) the technologies registered were of traditional tech fields (mechanical, chemical, etc.). Besides, the citations received (forward) by Korea and Taiwan outnumber the citations received by Mexico and Brazil. That means that the value of knowledge in Asian countries

is more important that the value in Latin American countries. This is very relevant because in the beginning Latin American countries had the same technological distribution as these Asian countries (see Chart 2 and 3).

Chart 2: Distribution of patents granted by tech field and average forward citations to residents in Korea and Taiwan (1976-2002)

		1985		1998		2002	
		Patents	Cites	Patents	Cites	Patents	Cites
1	Korea: all classes	41	3.5	3259	2.0	3786	2.5
	Chemical	17%	2.1	11%	1.9	10%	1.8
	Computers	10%	2.3	28%	2.2	30%	3.4
	Drugs	5%	1.5	2%	2.1	3%	1.1
	Electrical	5%	2.5	35%	2.6	37%	3.9
	Mechanical	22%	2.7	14%	1.9	11%	1.9
	Other	41%	5.2	11%	1.9	9%	1.2
	Receptacles	12%		0.5%			
	Apparel and textitle	10%		2%			
2	Taiwan: all classes	174	3.0	3100	2.0	5423	3.2
	Chemical	7%	2.7	8%	1.9	6%	1.8
	Computers	3%	3.3	10%	3.2	11%	2.5
	Drugs	2%	2.5	2%	1.0	3%	1.8
	Electrical	13%	3.4	34%	3.9	41%	4.3
	Mechanical	22%	1.7	19%	2.0	18%	1.9
	Other	52%	3.4	27%	2.0	21%	1.8
	Furniture,	11%		6%			
	Miscellaneous	20%		10%			

Sourse: National Bureau of Economic Research (NBER)

Chart 3: Distribution of patents granted by tech field and average forward citations to residents in Mexico and Brazil (1976-2002)

		1985		1998		2002	
		Patents	Cites	Patents	Cites	Patents	Cites
3	Mexico: all classes	32	0.5	57	0.4	94	0.2
	Chemical	13%	0.9	26%	0.7	20%	0.4
	Computers	3%	0.1	2%	0.0	6%	0.1
	Drugs	9%	0.1	18%	0.9	5%	0.4
	Electrical	13%	0.2	7%	0.4	5%	0.9
	Mechanical	31%	1.4	19%	0.5	34%	1.9
	Other	31%	2.0	28%	1.1	29%	0.9
4	Brazil: all classes	30	0.4	74	0.3	96	0.5
	Chemical	20%	0.4	18%	0.2	23%	1.1
	Computers	0%	0.0	11%	0.1	6%	0.1
	Drugs	7%	1.8	12%	0.7	15%	0.9
	Electrical	7%	0.4	4%	0.9	11%	0.9
	Mechanical	27%	1.9	19%	1.1	18%	0.1
	Other	40%	0.2	36%	0.8	27%	0.9

Sourse: National Bureau of Economic Research (NBER**)**

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